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10/814,768	03/31/2004	Kazuhito Nakamura	RAJ-018	8865

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EXAMINER	
LAFOND, RONALD D	

ART UNIT	PAPER NUMBER
1792	

NOTIFICATION DATE	DELIVERY MODE
12/31/2007	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/814,768	NAKAMURA ET AL.	
	Examiner	Art Unit	
	Ronald D. Lafond	1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10 October 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,8-16,18,23-32,34 and 35* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,8-16,18,23-32,34 and 35* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *04 October 2007* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. The Amendments of October 4, 2007, were received and have been entered. Claims 1, 8, 11, and 35 are acknowledged as amended. Claims 2 – 7, 17, 19 – 22, and 33 are acknowledged as cancelled. This Action is in response to Claims 1, 8 – 16, 18, 23 – 32, 34, and 35, which are currently pending.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1, 11, 12, 15, 16, and 23 are rejected under 35 U.S.C. 102(e) as being anticipated by Ohashi, et al. (United States Patent Application Publication US 2003/0064225 A1, hereafter Ohashi).

4. Regarding Claim 1, Ohashi teaches a method of processing a substrate (see Paragraph [0001]) on a ceramic substrate heater (see, e.g., Paragraphs [0033] and [0049]), the method comprising: forming a protective coating on the ceramic substrate heater in the process chamber prior to placing a substrate on the substrate heater (see, e.g., Paragraph [0046]), including: (a) exposing the ceramic substrate heater to a metal-containing gas to deposit a first layer of the metal on the ceramic substrate heater (see Paragraphs [0032] – [0034]; note that Paragraph [0034] teaches that "it is preferable to include at least one kind of a metal material ... selected from the group of tungsten and molybdenum between the basal material and the thin film ... [T]he intermediate layer may be formed by a well-known method. For instance, CVD ... may be included." Thus, Ohashi is inherently teaching the use of a metal-containing gas to deposit a first layer of the metal material on the ceramic substrate heater, as CVD is a vapor deposition method that must include a metal-containing gas in order to deposit a metal.), and (b) exposing the

ceramic substrate heater to at least one non-metal-containing gas to deposit the at least one non-metal on the first metal layer (see Paragraph [0040] and, e.g., Paragraph [0114), wherein the protective coating comprises a non-metal layer surface portion for receiving the substrate (see Paragraph [0041], and processing at least one substrate on the coated ceramic substrate heater (see again Paragraphs [0001], [0041], and [0046]).

5. Regarding Claim 11, Ohashi teaches the method wherein the non-metal layer surface portion is carbon/diamond (see, e.g., Paragraph [0041]).

6. Regarding Claim 12, Ohashi teaches the method wherein the ceramic substrate heater comprises AlN or SiC (see Paragraph [0033]).

7. Regarding Claims 15 and 16, Ohashi teaches the method wherein the non-metal-containing gas comprises methane (see Paragraph [0114]).

8. Regarding Claim 23, Ohashi teaches the method wherein the forming further comprises heating the substrate heater to 730 C (see again Paragraph [01 14]).

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

10. Claims 8, 25, 28, and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohashi in view of Leung, et al. (United States Patent 5,705,080, hereafter Leung).

11. Regarding this Claim, Ohashi teaches the method wherein the non-metal layer surface portion of the protective coating includes a first surface portion for receiving a substrate and a second surface portion that remains exposed when the first surface portion receives a substrate (see, e.g., Figures 5 and 6), and wherein the processing includes placing the at least one substrate on the first surface portion of the non-metal layer surface portion of the protective coating and thereafter subjecting the substrate to a

process (see also citations for Claim 1 regarding subjecting the substrate to a process). Ohashi does not teach the method wherein the process is a process during which a second layer of the metal is deposited on the second surface portion of the non-metal layer surface portion. However, Leung teaches a method comprising forming a seasoning protective coating on a substrate heater in a chamber and thereafter processing semiconductor wafers to deposit tungsten (see Column 1, lines 5 – 35 and Column 3, lines 43 – 53). Moreover, Leung specifically teaches the idea of seasoning the surface with the same metal that is to be deposited on the substrate (tungsten; see Column 8, lines 40 – 59). Furthermore, just as in Ohashi, Leung teaches the idea of using a seasoning layer to reduce and prevent wafer contamination (see, e.g., Paragraphs [0006] – [0009] and [0026] of Ohashi and Column 1, lines 23 – 35, of Leung). Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have modified the method taught by Ohashi by processing a semiconductor by depositing a second layer of the metal tungsten on the second surface portion of the non-metal layer surface portion, because Leung teaches that it is known to deposit tungsten onto substrates in a chamber that has been seasoned with a protective coating and because both Ohashi and Leung teach methods for the processing of semiconductor substrates in CVD reactors.

12. Regarding Claim 25, as discussed, Leung teaches the method wherein the processing comprises: providing a substrate to be processed on the coated ceramic substrate heater; performing a process on the substrate by exposing the substrate to a process gas; and removing the processed substrate from the process chamber (see Column 9, lines 55 – 63).

13. Regarding Claim 28, Leung teaches the method wherein the performing comprises carrying out a TCVD process (see again Column 9, lines 55 – 63).

14. Regarding Claim 29, Leung teaches the method wherein the performing comprises depositing a metal layer on the substrate (see again Column 9, lines 55 – 63).

15. Claims 13 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohashi in view of Sussmann (European Patent Application Publication 0 440 384 A1).

16. Regarding Claim 13, Ohashi does not teach the method wherein the metal of the protective coating comprises Cr. However, Sussmann teaches just such a limitation, wherein Cr is used as the

intermediate bonding layer between a ceramic substrate and a diamond-like protective thin film (see Column 1, lines 4, 5, and 40 – 47, and Column 2, lines 9 – 23). Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have modified the method taught by Ohashi by depositing a first chromium metal layer on the ceramic substrate heater, because Sussmann teaches that it is known in the art to use Chromium as an intermediate bonding layer between ceramic substrates and diamond-like protective thin films.

17. Regarding Claim 24, Ohashi does not teach the method wherein the forming further comprises heating the ceramic substrate heater to between about 300 C and about 600 C. However, Sussmann again teaches just such a limitation, in Column 3, lines 17 -- 21, wherein "a coating of a thin layer of amorphous or diamond-like carbon can be deposited on the metal layer using any of a variety of techniques such as radio frequency plasma assisted CVD at temperatures of the order of 300 C." Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have modified the method taught by Ohashi by heating the substrate heater to about 300 C during the forming of the protective coating, because Sussmann teaches that it is known to produce diamond-like thin films via CVD at such temperatures.

18. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ohashi in view of Sussmann, and further in view of Ludwig, et al. (United States Patent 4,248,943, hereafter Ludwig).

19. Regarding this Claim, Ohashi in view of Sussmann does not teach the method wherein the metal-containing gas comprises $Cr(CO)_6$. However, as discussed for Claim 13 above, Sussmann teaches that chromium is a known intermediate bonding layer between ceramic substrates and diamond-like carbon protective thin films. Ludwig teaches, in Column 3, lines 28 -- 40, that "the substrate ... can be coated with chromium ... by a number of processes, such as ... chemical vapor deposition from chromium carbonyl." Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have modified the method taught by Ohashi in view of Sussmann by employing chromium carbonyl as the precursor to deposit a chromium intermediate bonding layer on the ceramic substrate heater with a reasonable expectation of success.

20. Claims 30 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohashi in view of Ravi (United States Patent 5,952,060).

21. Regarding Claim 30, Ohashi does not teach the method further comprising repeating the forming and processing without cleaning the substrate heater. However, Ravi teaches just such a limitation, wherein, in a substrate processing apparatus which has been coated with a diamond-like carbon coating, the protective coating is reapplied after a substrate is processed (see Figures 3 and 4 and Claims 25 and 27). Moreover, Ravi discloses the advantages of maintaining a non-metal coating on the surface of parts that are exposed to reactants in substrate processing systems in order to "[reduce] the accumulation of residues and [reduce] the release of particulates and impurities during processing," (see Ravi Column 2, lines 29 – 31). Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have modified the method taught by Ohashi by repeating the forming and processing without cleaning the substrate heater in order to have achieved the advantages taught by Ravi.

22. Regarding Claim 31, Ohashi does not teach the method further comprising cleaning the substrate heater and repeating the forming and processing. Again, however, Ravi teaches these limitations. Ravi teaches, in Column 1, lines 25 – 27, that "the processing of substrates requires a carefully controlled environment to avoid contamination from ambient chemical species and defects caused by particulates." Ravi further teaches, in Column 1, lines 42 – 44, that "as a film is deposited on a substrate, some of the material being deposited also accumulates on the processing chamber's walls and must be removed periodically." Finally, as discussed, Ravi teaches, in Figure 4 and Column 9, lines 21 – 34, cleaning the interior of the chamber and repeating the forming and cleaning. Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have modified the method taught by Ohashi by performing the method further comprising cleaning the substrate heater and repeating the forming and processing as taught by Ravi to have achieved the process advantages taught by Ravi.

23. Claims 9, 10, and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohashi in view of Leung, and further in view of Ravi.

24. Regarding Claim 9, Ohashi in view of Leung teaches the method further comprising: removing the processed substrate from the process chamber (see especially Column 9, lines 55 – 63). However, Ohashi in view of Leung does not teach the method further comprising: again exposing the coated ceramic substrate heater to the at least one non-metal-containing gas to deposit an additional non-metal layer on the second metal layer and on the first surface portion of the non-metal layer surface portion. However, as discussed, Ravi teaches just such a limitation, wherein a diamond-like carbon protective thin film is reapplied after substrate processing. As discussed above, Ravi discloses the advantages of maintaining a non-metal coating on the surface of parts that are exposed to reactants in substrate processing systems in order to "[reduce] the accumulation of residues and [reduce] the release of particulates and impurities during processing," (see Ravi Column 2, lines 29 – 31). Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have modified the method taught by Ohashi in view of Leung by performing the method further comprising again exposing the coated ceramic substrate heater to the at least one non-meta—e non-metal layer surface portion as taught by Ravi to have achieved the advantages taught by Ravi.

25. Regarding Claim 10, Ravi teaches the method further comprising repeating the processing, removing, and again exposing until a desired number of substrates have been processed (see Figure 4, and Claims 25 – 27).

26. Regarding Claim 26, Ohashi in view of Leung does not teach the method further comprising forming a non-metal layer on the coated ceramic substrate heater following the removing, and repeating the processing at least once. However, as discussed, Ravi teaches just such limitations provides the proper motivation for the skilled artisan to do so. Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have modified the method taught by Ohashi in view of Leung by further forming a non-metal layer on the coated ceramic substrate heater following the removing, and repeating the processing at least once, for substantially the same reasons given for Claims 9 and 10.

27. Claim 27 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ohashi in view of Leung and Ravi, and further in view of Sussmann.

28. Regarding this Claim, Ohashi in view of Leung and Ravi does not teach the method wherein the non-metal layer comprises Si. However, Sussmann explicitly teaches that the protective coating may further comprise a silicon protective layer between the intermediate bonding metal layer deposited directly on the ceramic substrate and the diamond-like thin film (see Column 3, lines 5 – 13, Figure 2, and Claims 6 and 7). Sussmann teaches, in Column 3, lines 5 – 11, that "The [diamond-like thin film CVD deposition] environment may attack the metal bonding layer by forming hydrides, oxides, or halides. To minimise this problem, a layer of a protective material may be sandwiched between the CVD diamond film and the metal bonding layer. Examples of protective materials are ... materials such as silicon." Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have modified the method taught by Ohashi in view of Leung and Ravi by depositing a non-metal layer further comprising Si as taught by Sussmann to have achieved the advantages taught by Sussmann.

29. Claims 35 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Itatani, et al. (United States Patent Application Publication US 2002/0072211 A1, hereafter Itatani) in view of Kim, et al. (United States Patent 6,413,321 B1, hereafter Kim), Fukuda, et al. (United States Patent Application Publication US 2001/0037769 A1, hereafter Fukuda), Nakajima (United States Patent 6,452,775 B1), and Vaartstra, et al. (United States Patent 6,197,628 B1, hereafter Vaartstra).

30. Regarding this Claim, Itatani teaches a method of processing a substrate on a substrate heater in a process chamber (see Paragraph [0027]), comprising: processing at least one substrate on the substrate heater. More specifically, Itatani teaches the deposition of Ruthenium films for manufacturing semiconductor devices. Furthermore, Itatani teaches, in Paragraph [0006], that "in cases where films of [ruthenium complexes] are formed on a substrate by means of a thermal CVD method, films of Ru or RuO_2 are deposited on members around the substrate such as, for instance, a substrate holder, and when the deposition process is continued, there would be a problem in that these films peel off, resulting in the formation of particles on the substrate and hence in a reduction of manufacturing yield. In addition, when particles are generated, it is necessary to stop the operation of the semiconductor manufacturing apparatus for replacement of damaged component elements with new ones ..." Moreover, Kim teaches, in Column 1, lines 36 – 40, that "Particle contamination on the backside of wafers has become a serious

issue in advanced microelectronics manufacturing for several reasons. One reason is that particles on the backside of the wafer can cause cross contamination and electrical contact failures in interconnect structures." Kim further teaches, in Column 2, lines 6 – 15, "methods of reducing the number of particles and other contaminants formed on the backside of wafers during semiconductor processing ... A seasoning reaction is performed to coat interior chamber surfaces and the wafer heater with a coating." Kim finally teaches, in Column 7, lines 46 – 58, that "A CVD chamber may be seasoned ... [by] depositing a thin layer of material over the chamber walls before a substrate is introduced into the chamber for processing ... This seasoning gas causes a coating to form over exposed surfaces of the wafer heater. This seasoning coating is intended to lock in place particulate contamination remaining following the prior cleaning step." Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have modified the method taught by Itatani by first forming a protective coating on the substrate heater in the process chamber prior to placing a substrate on the substrate heater, wherein the protective coating comprises a surface portion for receiving a substrate, because Kim teaches that such a method reduces particle contamination, and because both Itatani and Kim discuss the need to reduce such particulate contamination in semiconductor manufacturing processes.

31. Itatani in view of Kim does not teach the method comprising a ceramic substrate heater. However, as discussed, Itatani and Kim both discuss the need to reduce particle contamination in semiconductor manufacturing processes. Fukuda teaches, in Paragraph [0010], that "there has been a necessity of preventing metal contamination from being caused by a metallic susceptor or a heater. To solve this problem, a ceramic heater has been proposed. The heater is manufactured of alumina ceramic or aluminum nitride which has a resistance to the plasma, so that impurity contamination is reduced." Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have modified the method taught by Itatani in view of Kim by employing a ceramic substrate heater as taught by Fukuda to have further reduced the particle contamination in the substrate.

32. Further regarding Claim 35, Nakajima teaches however that ceramic layers themselves contain impurities. Nakajima teaches, in Column 1, lines 1 and 2, and Column 2, lines 1 – 10, that "the ceramic layer ... includes impurities such as titanium oxide, chromic oxide, magnesia, and the like to provide the

desired conductivity. These impurities are problematic because they may contaminate the backside of the semiconductor wafer... In view of the foregoing, there is a need for a [ceramic] chuck that minimizes contamination of the backside of the wafer." Nakajima further teaches, in Column 2, lines 37 – 48, that "a method for manufacturing an electrostatic chuck is provided. In this method, a metal substrate is provided. A ceramic layer is formed over the metal substrate. A high purity barrier layer is formed over the ceramic layer. The high purity barrier layer may be formed by chemical vapor deposition... The electrostatic chuck significantly reduces contamination of the backside of the semiconductor wafer and allows for smooth de-chucking of the wafer." Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have modified the method taught by Itatani in view of Kim and Fukuda by employing a high purity barrier layer as the protective coating on the ceramic substrate heater as taught by Nakajima to have achieved even greater reduction in contamination.

33. Finally regarding Claim 35, Vaartstra teaches the deposition of $RuSi_x$ diffusion barrier layers via CVD. That is, Vaartstra teaches a method of forming a protective coating, including (a) exposing the substrate to a metal-containing gas to deposit the metal, wherein the metal-containing gas comprises a Ru-containing gas, and (b) exposing the substrate to at least one non-metal containing gas to deposit the at least one non-metal, wherein the non-metal-containing gas comprises a silicon-containing gas, wherein the surface portion is a combined metal/non-metal layer (see Column 2, lines 32 – 46; Column 4, lines 4 – 15; and Column 6, lines 60 – 63). Vaartstra teaches, in Column 4, lines 9 -- 15, that "$RuSi_x$ diffusion barrier layer[s may be used] for any application requiring an effective barrier layer, for example, to prevent diffusion from a silicon containing surface. In other words, the $RuSi_x$ diffusion barrier layer may be used ... wherever it is necessary to prevent the diffusion of one material to an adjacent material." Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have modified the method taught by Itatani in view of Kim, Fukuda, and Nakajima by employing an $RuSi_x$ diffusion barrier layer formed as taught by Vaartstra as the specific barrier layer protective coating for the ceramic substrate heater protective coating with a reasonable expectation of success, because Nakajima teaches that barrier layers may effectively be used to prevent backside contamination of semiconductor

wafers from ceramic substrate heaters and because Vaartstra teaches that $RuSi_x$ barrier layers are known to prevent the diffusion of one material to an adjacent material.

34. Regarding Claim 18, Vaartstra teaches the method wherein the metal-containing gas comprises $Ru3(CO)_{12}$ (see Column 6, lines 28 – 31) and the non-metal-containing gas comprises SiH_4 (see Column 6, lines 34 – 36).

35. Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over Itatani in view of Kim, Fukuda, Nakajima, and Vaartstra, and further in view of Marsh, et al. (United States Patent Application Publication US 2002/0025627 A1, hereafter Marsh).

36. Regarding this Claim, the references cited to reject Claim 35 fairly teach a method of processing a substrate on a ceramic substrate heater in a process chamber, the method comprising: forming a protective coating on the ceramic substrate heater in the process chamber, including: exposing the ceramic substrate heater to $Ru_3(CO)_{12}$ to deposit a Ru layer on the ceramic substrate heater, and exposing the ceramic substrate heater to SiH4 to deposit a Si layer on the Ru layer; and processing at least one substrate on the coated ceramic substrate heater, including: providing a substrate to be processed on the coated ceramic substrate heater, performing a Ru deposition on the substrate; and removing the processed substrate from the process chamber (see analysis and rejection of Claim 35).

37. Itatani in view of Kim, Fukuda, Nakajima, and Vaartstra does not fairly teach the limitations that, a) the protective coating comprises a Si/Ru protective coating in which the Si layer is deposited after the deposition of the Ru layer on the substrate heater, and b) that the Ru deposition process on the substrate is performed by exposing the substrate to $Ru_3(CO)_{12}$. Regarding the second limitation, as discussed, Vaartstra teaches that Ru may be deposited via CVD from a $Ru_3(CO)_{12}$ precursor; Itatani teaches generally the deposition of Ru layers via CVD. Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have modified the method taught by Itatani by utilizing $Ru_3(CO)_{12}$ as the gaseous precursor in the CVD of Ru in the overall process taught by Itatani in view of Kim, Fukuda, Nakajima, and Vaartstra, because Vaartstra teaches that $Ru_3(CO)_{12}$ is a known precursor in the CVD of Ru layers.

38. Regarding the first limitation, Marsh teaches, in Paragraph [0012], that it is known to deposit $RuSi_x$ layers via atomic layer deposition (ALD). Because ALD involves the deposition of layers via the discrete and iterated deposition of different monolayers, Marsh is inherently teaching the deposition of an Si/Ru coating in which the Si layer is deposited after the deposition of the Ru layer. Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have modified the method taught by Itatani in view of Kim, Fukuda, Nakajima, and Vaartstra by depositing the protective Si/Ru coating via ALD such that a Si layer is deposited onto a Ru layer as taught by Marsh with a reasonable expectation of success, because Vaartstra teaches that $RuSi_x$ layers are barrier layers, and because Marsh teaches that it is known to deposit such $RuSi_x$ barrier layers via ALD.

39. Claim 34 is rejected under 35 U.S.C. 103(a) as being unpatentable over Itatani in view of Kim, Fukuda, Nakajima, Vaartstra, and Marsh, and further in view of Ravi.

40. Regarding this Claim, Itatani in view of Kim, Fukuda, Nakajima, Vaartstra, and Marsh does not teach the method further comprising forming a Si layer on the protective coating following the removing, and repeating the processing at least once. However, as discussed, Ravi teaches the idea of re-applying a protective coating after processing a substrate (see Figure 3). Therefore, it would have been obvious to one having ordinary skill in the art at the time of the present invention to have modified the method taught by Itatani in view of Kim, Fukuda, Nakajima, Vaartstra, and Marsh by re-coating the interior of the chamber with a protective coating comprising Si as suggested by Ravi with a reasonable expectation of success, because Vaartstra in view of Marsh teaches that it is known to apply $RuSi_x$ barrier layers via ALD, and because Ravi teaches that it is known in the art to re-coat the surfaces of a processing apparatus with a protective coating after each substrate processing step.

Response to Arguments

41. The Examiner acknowledges receipt of the amended Drawings correcting the previous deficiency.

42. Applicants' arguments with respect to the rejections of Claims 7 – 11, 14 – 16, 18, 30, 32, 34, and 35 under 35 U.S.C. 103(a) over Fukuda and its various secondary references have been considered but are moot in view of the new ground(s) of rejection.

43. Applicants' arguments concerning the propriety of the use of Fukuda as a primary reference and the lack of motivation to combine it with Ohashi, et seq., are acknowledged. Fukuda is now only cited in a secondary capacity to demonstrate the benefits of using a ceramic substrate heater.

44. In light of the amendments to Claim 1, the rejections of Claims 1, 12, 13, 15, 16, 23 – 29, and 31 under 35 U.S.C. 102(b) by Fukuda are properly withdrawn.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ronald D. Lafond whose telephone number is (571) 270-1878. The examiner can normally be reached on M - F, 9:30 AM - 6 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Cleveland can be reached on (571) 272-1418. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

RDL

MICHAEL CLEVELAND
SUPERVISORY PATENT EXAMINER